SOLIDIGM

Solidigm™ P41 Plus

SOLUTION BRIEF

Excellent Performance for Everyday Work and Play

The P41 Plus is an innovative PCIe 4.0 SSD that delivers an excellent value to PC users for everyday productivity and gaming. The free, optional Solidigm Synergy software enhances performance even further by optimizing the relationship between PC and SSD.

Product Overview

The P41 Plus features 144-layer 3D NAND, a PCIe 4.0 interface, and is available in an M.2 2280 form factor in capacities of 512GB, 1TB, and 2TB.

Capable of delivering up to 4,125 MB/s sequential read speed, the P41 Plus represents a breakthrough in cost efficiency, delivering great performance at a price that won't break the budget for everyday PC users.

Key Features

Performance with Impact on real-world workloads

Solidigm has taken a thorough approach to client workload analysis and SSD design across many use cases – from daily student and office work to enthusiast-level gaming and content creation – to understand the actual components of user experience. As a result, Solidigm has designed the P41 Plus to work best for the real-world workloads and applications that you use daily.

Power and Thermal Efficiency

The P41 Plus is optimized for power savings and thermal efficiency to help deliver consistent performance with minimal throttling.

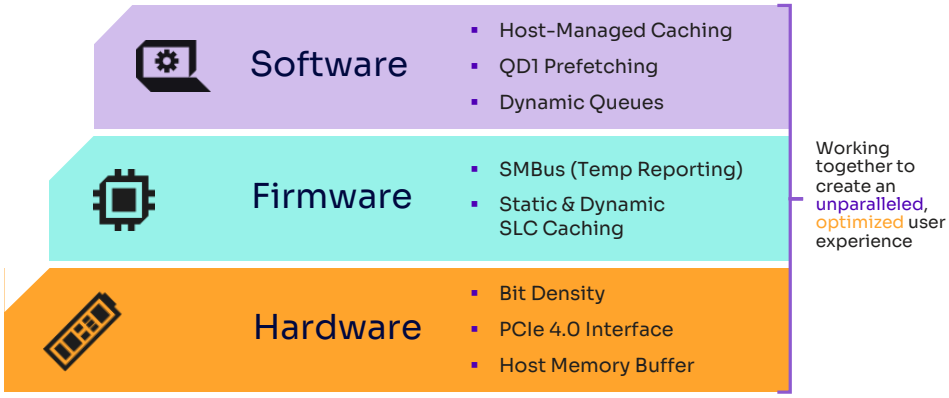
Endurance and Reliability

The P41 Plus is highly durable, allowing you to write more data and read it back with fewer errors over the life of your SSD. You can write hundreds of GB to the drive every day over a five-year warranty period, enabling you to rely on the P41 Plus to provide consistent high performance for the life of your SSD.

Increased Performance and Consistency with Solidigm Synergy

Combine the P41 Plus with the Solidigm Synergy software for a complete client storage solution. Solidigm Synergy enhances performance with a new level of communication between the P41 Plus and your PC, enabling the SSD to optimize your most important files and optimizations for quickest access.

For information on Solidigm Synergy, see www.solidigm.com/synergy



P41 Plus Features

Performance With Impact

Most performance figures on the front of an SSD retail box and in product specification documents are based on pure I/O types at high queue depth (often 32). These figures approach theoretical maximum drive performance but are not necessarily well aligned to real-world usage.

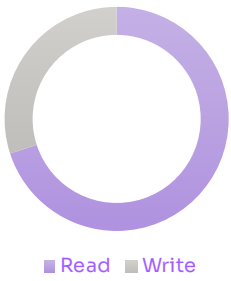
User experience obviously varies depending on what the user is doing, but there are important general trends: PC storage usage tends to be mostly read, mostly random, and nearly all at very low QD.

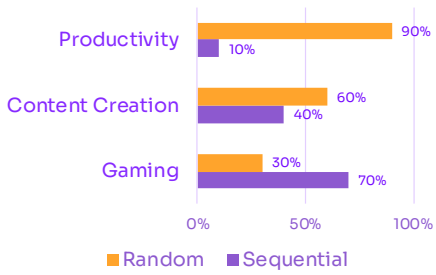
Solidigm has optimized the P41 Plus for the real-world workloads and applications that you use daily.

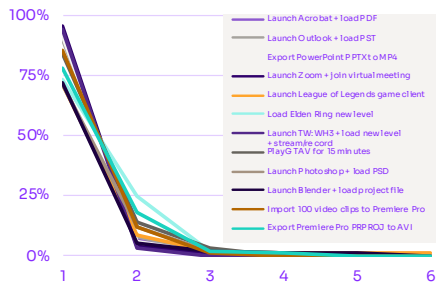
Background on queue depth: Any workload, even a small one, will generate a huge number of I/O operations. The SSD will process those as quickly as possible, but sometimes a queue, or line, forms of waiting requests. Thanks to clever architecture, modern SSDs can service multiple requests in the queue at a time. Consequently, performance measured in terms of data throughput will be highest at high QD, when multiple requests are processing at once.

But many typical PC workloads just don't form long queues because the SSD is responding as quickly as the requests come in. In fact, Solidigm internal research indicates that more than 90% of typical workloads operate at QD of 1 or 2.

Read/Write Mix	Random/Sequential Mix	Queue Depth
A mix of read/write activity	Mixed; random predominant	> 90% at QD 1-2







Solidigm client SSDs are built to perform best where it impacts users most

Power and Thermal Efficiency

Save battery life and avoid throttling with a highly efficient SSD architecture.

When an SSD takes on heavy workloads, they consume more power and generate more heat. Overheating could possibly lead to electronic component damages and system failures, so typically any SSD that is starting to overheat is "throttled" – in other words, temporary limited to lower performance – to help it cool down.

Solidigm's P41 Plus is designed with power optimization and thermal efficiency in its DNA. The P41 Plus is built on a highly efficient architecture that not only helps users save battery life while on the go, but also includes algorithms to help provide consistent performance under heavy workloads.

Endurance and Reliability

Write more data and read it back with fewer errors – backed by a 5-year warranty.

The P41 Plus is highly durable, allowing you to write hundreds of GB of data daily and read it back error without error for the life of your SSD. With a 5 year warranty, you can rely on the P41 Plus to preserve your data for the life of your SSD.

Solidigm Synergy Software

Transparently improves your user experience with performance-optimizing features.

Solidigm Synergy is a free software suite for PCs running Microsoft Windows that unlocks innovative new features on Solidigm SSDs. By closing the gap between the storage device and the rest of the system, Solidigm Synergy enables a more optimized user experience than hardware alone can provide.

There are two components of Solidigm Synergy, both optional but highly recommended:

- The Solidigm Storage Driver automatically and invisibly boosts performance by making "under-the-hood" improvements to the connection between SSD and host system.
- The Solidigm Storage Tool offers a modern user interface for drive health and information reporting, plus the ability to manually trigger useful functions such as Diagnostic Scan and Secure Erase.

High Endurance		
P41 Plus 512 GB	**P41 Plus** 1 TB	**P41 Plus** 2 TB
Endurance Rating 200 TBW	**Endurance Rating** 400 TBW	**Endurance Rating** 800 TBW
Equivalent to 110GB written per day over 5-year warranty period	**Equivalent to** 219GB written per day over 5-year warranty period	**Equivalent to** 438GB written per day over 5-year warranty period

	Solidigm Storage Driver	Solidigm Storage Tool
Capabilities	Enhances user experience by "closing the gap" between host and storage device to automatically optimize performance and power	Enables users to view drive health reports and trigger useful manual functions API for integration into customer tools
SSD compatibility	**All Solidigm SSDs** – baseline performance improvement of up to 10% over Windows generic disk driver. Driver will load but HMC only supported on P41 Plus today **Solidigm P41 Plus** – Host-Managed Caching feature delivers an additional performance improvement of up to 10% over Windows in-box PCIe driver Not supported on non Solidigm drives. Default to inbox driver	Device identification and SMART reporting, plus useful Firmware Update, Diagnostic Scan, and Secure Erase features
Platform compatibility	Windows on Intel or AMD	Windows on Intel or AMD
Required for Solidigm SSDs?	No, but strongly recommended	No, but strongly recommended
Cost	Free	Free

For further information on Solidigm Synergy and for free download, see www.solidigm.com/synergy

Solidigm Storage Driver

The Solidigm Storage Driver enables a new level of communication between SSD and host that includes detailed information – not just about what data is being stored, but how important it is to the user. By leveraging this new communication path, the driver can help the SSD optimize how data is stored, ensuring the most useful stuff is available most quickly when needed.

Hardware and firmware innovations have advanced SSD performance and efficiency greatly over the years. But without software, even the most advanced drive today does not actually know much about what it's storing. SSDs see their contents in terms of logical block addresses, or LBAs – ignorant of whether a given LBA range references an application, a set of family photos, or any other data type.

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Key feature: Host-Managed Cache

The marquee feature in Solidigm Synergy 1.0 is Host-Managed Caching, which optimizes the use of our SSD's **SLC cache** to intelligently serve up the user's most important files and applications at the fastest rate.

A quick primer on the SLC cache is in order. Virtually every client SSD uses one these days. Modern SSDs store three (TLC) or four (QLC) bits per cell, which enables higher densities and lower costs, but the tradeoff is performance – it takes longer to access data in a cell storing multiple bits. To mitigate this tradeoff, most SSDs are shipped with a proportion of their cells set to store one bit each (the SLC cache). Data stored in the SLC cache can potentially be read back much more quickly than data in TLC or QLC cells.

By default, the **conventional SLC** cache implementation is based on write recency. That is, whatever was written to the SSD most recently will go into the cache. It remains there as long as it can (depending on the size of the cache) until more

recent data comes along and kicks it out to the non-cached portion of the drive.

This works great as long as the user only needs to access recently written data. But what if you are often accessing photo sets, games, or other files that were put on the drive more than a few weeks ago?

That's where **Host-Managed Caching** comes in. By leveraging the closer relationship between system and SSD that the driver facilitates, HMC enables the drive to actually see what file types it's storing and how often the user asks for them.

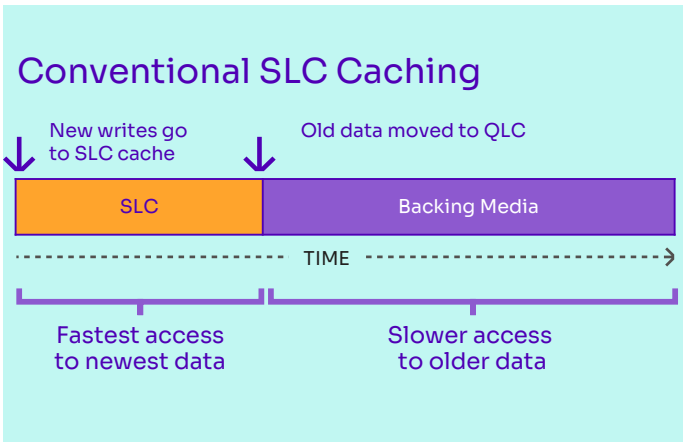
That information, which is inaccessible to an SSD without the help of a driver, unlocks all sorts of possibilities. The drive can now assign a "priority" to each block of data based on its usage characteristics. It can then intelligently sort the contents of the entire drive and ensure that the most useful data is always available in the SLC cache. And it can even "re-insert" older data back into the SLC cache if, for whatever reason, the user begins requesting it more often again – an impossible move under the conventional approach.

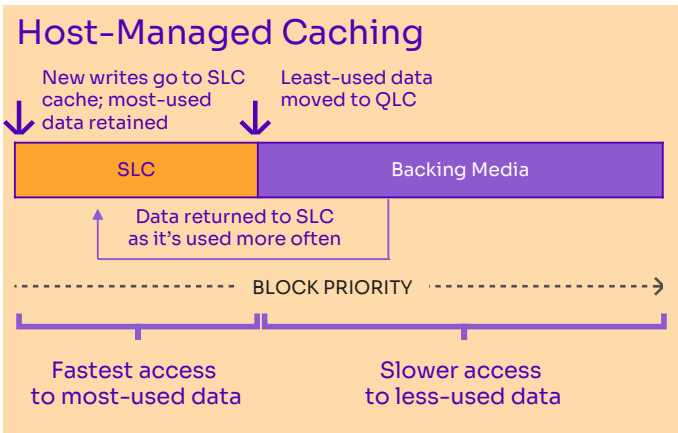
Solidigm Storage Tool

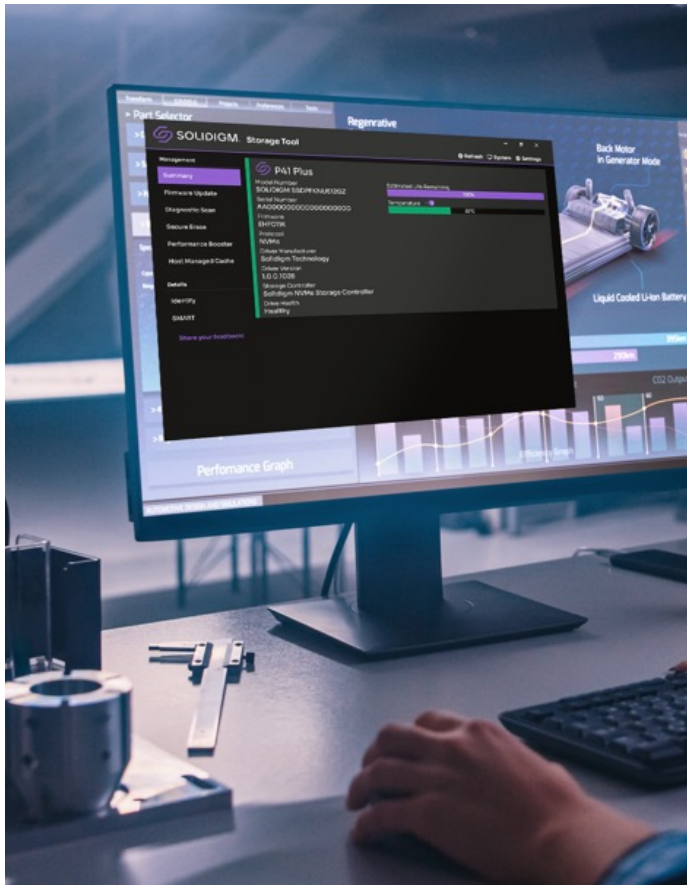
Solidigm Synergy includes the Solidigm Storage Tool, an application that provides SSD health reports and enables users to trigger useful manual functions, such as trim, secure erase, and diagnostic scan. The Solidigm Storage Tool has two interfaces: a GUI to manage the SSD and a Command Line Interface (CLI) to update and configure the drive.

The Solidigm Storage Tool offers:

- Drive health checks
- Estimated drive life remaining
- SMART (Self-Monitoring and Reporting Technology) logs and attributes
- Firmware updates
- Optimizing drive performance with the SSD Optimizer
- Quick or complete diagnostic scans







Specifications

Available Capacities	512GB	1TB	2TB
Performance Specifications			
Sequential Bandwidth - 100% Read (up to)	3500 MB/s	4125 MB/s	4125 MB/s
Sequential Bandwidth - 100% Write (up to)	1625 MB/s	2950 MB/s	3325 MB/s
Power - Active	80mW		
Power - Idle	25mW		
Reliability			
Vibration - Operating	2.17 GRMS (5-700Hz)		
Vibration - Non-Operating	3.13 GRMS (5-700Hz)		
Shock (Operating and Non-Operating)	1,000 G (Max) at 0.5 msec 1,500 G (Max) at 0.5 msec		
Operating Temperature Range	0°C to 70°C		
Operating Temperature (Maximum)	70 °C		
Operating Temperature (Minimum)	0 °C		
Endurance Rating (Lifetime Writes)	200 TBW	400 TBW	800 TBW
Mean Time Between Failures (MTBF)	1.6 million hours		
Uncorrectable Bit Error Rate (UBER)	< 1 sector per 10^{15} bits read		
Warranty Period	5 years		
Package Specifications			
Form Factors	M.2 22 x 80mm		
Interface	PCIe 4.0 x4 | NVMe		
Advanced Specifications			
Hardware Encryption	No		
End-to-End Data Protection	Yes		
NSIT Secure Erase	No		